Claims 1-11 are pending in the application, with Claims 1 and 8-11 being independent. Claims 1-4, 6, and 8-11 and the specification have been amended herein. It is submitted that no new matter has been added.

Objections to Drawings

The Examiner has objected to the drawings on the grounds that reference signs 1020, 1024a and 1024b in Fig. 1 and "I" in Figs. 8-15 are not mentioned in the description. The drawings are also objected to on the grounds that reference signs Ia, Ib, Ic, Id and Ie in the figures are referred to as 1a, 1b, 1c, 1d and 1e in the specification. Without conceding the propriety of these objections, to expedite prosecution, the specification has been amended so as to mention the above-noted reference signs. Applicants respectfully request that these objections be withdrawn.

Section 112 Rejections

Claims 1-11 were rejected under 35 U.S.C. § 112, second paragraph, as allegedly indefinite, with respect to the term "colorant-containing resin" used in Claims 1 and 8-11. The

Examiner also takes the position that Claims 1, 6, 8, 9, 10 and 11 are indefinite for reciting improper Markush groups. The Examiner also takes the position that the scope of Claim 3 is confusing vis-à-vis the recitations of Claim 2, from which it depends.

Without conceding the propriety of any part of these rejections, to expedite prosecution, the independent claims have been amended to recite that the resin encapsulates the colorant; Claims 1, 6 and 8-11 have been amended with respect to the format of the Markush group language, and Claim 3 has been amended to depend only from Claim 1. Applicants submit that the claims and specification comply with all aspects of Section 112, and respectfully request withdrawal of these rejections.

Section 103(a) Rejections

Claims 1 and 5-11 were rejected under 35 U.S.C. § 103(a) as allegedly obvious over Sacripante et al. (U.S. Patent No. 6,251,987) in view of Suzuki et al. (U.S. Patent No. 6,153,001). Claims 2 and 3 were rejected over the same two references and further in view of either Tsang et al. (U.S.

Patent No. 5,886,065) or Johnson et al. (U.S. Patent No. 5,922,118).

Claims 1 and 4-11 were rejected under 35 U.S.C. § 103(a) as allegedly obvious over Tsutsumi et al. (U.S. Patent No. 6,031,019) in view of Suzuki et al. Claims 2 and 3 were rejected over the same two references and further in view of either Tsang et al. or Johnson et al.

Claims 1-7 were rejected under 35 U.S.C. § 103(a) as allegedly obvious over Shintani et al. (U.S. Patent No. 4,623,689) in view of either Tsang et al. or Johnson et al.

Claims 1 and 4-11 were rejected under 35 U.S.C. § 103(a) as allegedly obvious over Ito (U.S. Patent No. 5,693,126) in view of either Tsutsumi et al. or Shintani et al. (U.S. Patent No. 4,623,689). Claims 2-3 were rejected over the same combination of references, and further in view of either Tsang et al. or Johnson et al.

Claims 1-11 were rejected under 35 U.S.C. § 103(a) as allegedly obvious over Suzuki et al. in view of either Tsutsumi et al. or Shintani et al.

In Applicants' view, the cited references do not teach or suggest the claimed invention, either singly or in the combinations proposed by the Examiner.

Features of the Present Invention

Before addressing the merits of the rejections, Applicants believe it will be helpful to review some features and advantages of the claimed invention. The present invention, as recited in independent Claim 1, relates to an aqueous ink composition for ink jet comprising:

(i) a resin encapsulating a colorant and having a cationic hydrophilic group,

(ii) a self-dispersing pigment having a cationic hydrophilic group bonded to the surface directly or via another atomic group, or a pigment fine particle dispersed with a dispersant having a cationic hydrophilic group;

(iii) a polyhydric alcohol; and

(iv) a compound selected from the group consisting of a compound represented by general formula (I), a compound represented by general formula (II), and mixtures thereof.

Independent Claims 8-11 recite an ink cartridge, a recording unit, an ink-jet recording apparatus and an ink-jet recording method using such an ink.

In order to obtain, by ink-jet recording, an image having high optical density and excellent rub-off resistance, water fastness and resistance to line marker, inks containing a water-insoluble coloring material (for example, a pigment) have been developed. Ink containing a pigment or ink containing a pigment and resin, however, may suffer from poor intermittent ejection stability, distorted printing or ejection defect.

It has been found that when urea is added to an ink containing a cationic pigment and a coloring material encapsulated with a cationic resin in order to solve such problems, the ink still has a problem of storage stability. Therefore, further investigation was made to find out that good storage stability can be obtained when a polyhydric alcohol and an urea derivative according to formula (I) or (II) are added to such an ink, thus providing the present invention.

Experimental Results

Applicants submit the results of the following additional experiment, showing that ethylene urea is superior to urea with respect to providing stability of an ink in long-term storage.

Additional Experiment

Ink Composition of Example 3 (See page 53 of the specification.)

- Carbon black-containing cationic resin particles (using 10 ml of the aqueous dispersion as prepared in Example 2) 2.0 parts
- Cationic self-dispersing carbon black particles 4.0 parts
- Glycerol 5.0 parts
- Ethylene urea 10.0 parts
- Ion exchanged water 79.0 parts

Ink Composition of Comparative Example 2

- Carbon black-containing cationic resin particles (using 10 ml of the aqueous dispersion as prepared in Example 2) 2.0 parts

·Cationic self-dispersing carbon black particles 4.0 parts

·Glycerol 5.0 parts

·Urea 10.0 parts

·Ion exchanged water 79.0 parts

Evaluation

With the inks of Example 3 and Comparative Example 2, storage stability in a prolonged period was evaluated, using the following evaluation method and criteria for ink storage stability.

Each ink was put in a glass vessel with a tight seal, and kept in an incubator at 60°C for two weeks. If aggregation of pigment particles or increased viscosity was observed in the ink after incubation, the ink was evaluated "B"; if not, the ink was evaluated "A". The result is shown in Table 3.

Table 3

	Ink storage stability
Example 3	A
Comparative Example 2	B

Patentability over the Cited References

The originally-filed claims were rejected as being obvious over various combinations of Sacripante et al., Suzuki et al., Tsang et al., Johnson et al., Tsutsumi et al., Shintani et al. and Ito. First of all, Applicants assert that the combined use of a resin-encapsulated colorant and a self-dispersing or dispersed pigment in an aqueous ink-jet ink in order to obtain high image density and good rub-off resistance is not obvious from any of the cited preferences. In addition to that combination, by use of a polyhydric alcohol and a urea derivative of formula (I) or (II), the present invention further improves the intermittent ink ejection properties and the storage stability of an ink containing cationic resin particles and cationic self-dispersing pigment.

Sacripante et al. discloses an ink-jet ink composition containing pigment particles (which are not self-dispersing) and colored resin particles made from dye-containing monomers (not resin particles encapsulating a coloring material). It discloses use of polyhydric alcohol as a water-miscible solvent and urea as a humectant.

Suzuki et al. discloses an ink-jet ink containing a self-dispersing pigment that may contain urea or urea derivatives to prevent clogging of the nozzle. Applicants note that the self-dispersing pigment may be nonionic, anionic or cationic, and that the only example using a urea derivative is Example II-4, where ethylene urea and an anionic self-dispersing pigment were used. Nothing is disclosed about the superiority of urea derivatives (such as ethylene urea) to urea with respect to storage stability or other properties of an ink containing cationic self-dispersing pigment or cationic resin particles.

Tsang et al. and Johnson et al. disclose cationic self-dispersing pigments.

Tsutsumi et al. discloses an aqueous ink-jet ink composition comprising a compound represented by formula (1), (2) or (3), and pigment fine particles encapsulated into fine polymer particles. Polyhydric alcohol may be included as a wetting agent. Applicants submit, however, that none of formulas (1) to (3) encompasses ethylene urea or propylene urea, and it is stated that urea is especially preferred for formula (3).

Shintani et al. discloses an aqueous ink-jet ink containing colored polymer particles or aqueous colored polymer

and polyhydric alcohol. Applicants submit that since the colored polymer particles are polymer particles to which a basic dye is bound by ionic bonding, they are not resin particles encapsulating a colorant as recited in the present invention.

The Examiner alleges at page 10 of the Office Action that the ink of Shintani et al. contains 5-50% ethylene urea, but Applicants respectfully disagree. Shintani et al. states that when water-soluble polymer becomes water-insoluble by dyeing it with a basic dye, a water-soluble organic solvent of Shintani et al.'s formula (I) or (II) is added for solubilization. Applicants submit that neither (I) nor (II) represents ethylene urea or a derivative thereof, since Y in formula (II) is methylene or oxygen (column 8, lines 18-67).

Ito discloses a water-based ink composition comprising a colorant which is sparingly soluble or insoluble in water. The colorant is first dissolved in a solid solvent such as carboxylic acid derivatives and urea derivatives to form a solid solution and then is diluted with water. The ink may contain an alcohol such as glycerin and diethylene glycol as a surface tension modifier, and urea or propylene urea as a hydrotropy agent. Applicants therefore submit that the colorant

is distinctly different from a self-dispersing pigment, and that no cationic resin particles or cationic pigment is disclosed in Ito.

Regarding the rejections based on Sacripante et al. and Suzuki et al., Applicants submit that a combination of the colored resin particles of Sacripante et al. and the ethylene urea of Suzuki et al. and the self-dispersing pigment of Tsang et al. or Johnson et al. would not result in the present invention, since the colored resin particle of Sacripante et al. is not a colorant encapsulated in a cationic resin particle.

Regarding the rejections based on Tsutsumi et al. and Suzuki et al., Applicants further submit that there is no motivation to combine the cationic resin particles of Tsutsumi et al. and the ink of Suzuki et al. containing a self-dispersing pigment and urea or a urea derivative, since in Tsutsumi et al., a necessary component to be used with such resin particles in the ink is defined by one of formulas (1) to (3), which do not include ethylene urea or propylene urea. Moreover, Applicants submit that in Suzuki et al., ethylene urea is used only in Example II-4 with CAB-O-JET 300, which is an anionic self-dispersing pigment, and nothing is mentioned about the superior

effect of urea derivatives such as ethylene urea on the storage stability of an ink containing a cationically dispersed pigment and a colorant encapsulated in cationic resin particles.

Regarding the rejection based on Shintani et al., Applicants reiterate that, the colored polymer particles of Shintani et al. are different from the colorant encapsulated into resin particles of the present invention. Nothing is disclosed about cationic resin particles encapsulating a colorant or ethylene urea, which are features of the ink of the present invention. Thus, Applicants conclude that combining Shintani et al. and Tsang et al. or Johnson et al. would not result in the present invention, nor would it indicate the solution to the technical problem addressed by the present invention.

Regarding the rejections based on Ito, Applicants reiterate that the colorant of Ito is not a cationic self-dispersing pigment or a pigment dispersed with a cationic dispersant. In Ito, a colorant is made into a solid solution, and then dispersed in an aqueous medium. Thus, Applicants conclude that combining Ito and Tsutsumi et al. or Shintani et al. would not result in the invention of Claims 1 and 4-11. Similarly,

combining Ito, Tsutsumi et al. or Shintani et al. and Tsang et al., or Johnson et al. would not result in the invention of Claims 2-3.

Regarding the rejection based on Suzuki et al. in view of either Tsutsumi et al. or Shintani et al., Shintani et al. does not disclose an ink containing a coloring material encapsulated with a cationic resin or use of ethylene urea in the ink, as explained above. Thus, if Shintani and Suzuki are combined, the features of the present invention would not be obtained. Also, as Applicants have explained above, there is no motivation to combine the resin particles of Tsutsumi and the ink of Suzuki that contains a self-dispersing pigment and ethylene urea, since in Suzuki, ethylene urea is used only in Example II-4 with CAB-O-JET 300 (which is an anionic self-dispersing pigment). Moreover, Applicants note that nothing is mentioned about the superior effect of urea derivatives such as ethylene urea on the storage stability of an ink containing a cationic self-dispersing pigment and a cationic resin encapsulating a colorant.

Accordingly, Applicants conclude that none of the cited references, whether taken alone or in combination, (Sacripante et al., Suzuki et al., Tsang et al., Johnson et al.,

Tsutsumi et al., Shintani et al., and Ito) teach or suggest the features of the claimed invention, and respectfully request that all the Section 103(a) rejections be withdrawn.

Conclusion

Accordingly, Applicants submit that the present invention is patentably defined by independent Claims 1 and 8-11. The dependent claims are allowable for the reasons given with respect to independent Claim 1 and because they recite features which are patentable in their own right. Individual consideration of the dependent claims is respectfully solicited.

The Examiner has made of record, but not relied upon, Yamashita et al. (U.S. Patent No. 5,969,005), Yui et al. (U.S. Patent No. 5,948,155) and Lin (U.S. Patent No. 5,851,274). In Applicants' view, these references do not teach or suggest the features of the claimed invention, either, nor do they disclose the technical problems solved by the present invention, or the superior effect of ethylene urea or propylene urea.

In view of the above amendments and remarks, the claims are now in allowable form. Therefore, early passage to issue is respectfully solicited.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO SPECIFICATION

The paragraph starting at page 30, line 27 and ending at page 31, line 9 has been amended as follows.

--In Fig. 1, the ink jet printer includes: a driving part 1020 and a conveyor 1030, including roller units 1024a and 1024b, for intermittently conveying a sheet 1028 as a recording material in a direction shown by an arrow P in Fig. 9, the conveyor being disposed along a longitudinal direction in a casing 1008; a recorder 1010 reciprocating substantially parallel to a direction S crossing at right angles to the conveying direction P of the sheet 1028 by the conveyor 1030; and a movement actuator 1006 as driving means for reciprocating the recorder 1010.--

The paragraph starting at page 37, line 1 and ending at line 8 has been amended as follows.

--Figs. 8 to 15 are sectional views showing the liquid ejecting operation of the liquid ejection head shown in Figs. 3

to 7, and are sectional views along line X-X of the bubbling chamber 1337 shown in Fig. 7. An end of the ejection port portion 940 in the thickness-wise direction of the orifice plate in the cross section constitutes the top 1141a of a groove 1141, which contains ink I.--

The paragraph starting at page 38, line 12 and ending at line 23 has been amended as follows.

--Here, in the present example, a plurality of grooves 1141 are dispersed in the ejection port portion. When the meniscus 102 moves backward, a capillary force acts in a direction F_C opposite to a meniscus backward direction F_M in a part of the groove 1141. As a result, even if a slight dispersion is recognized on the state of the bubble 101 for some cause, a shape of meniscus or main ink droplet (hereinafter referred to as liquid or ink in some cases) Ia [1a] during retreat of the meniscus is corrected in such a manner that the shape is substantially symmetrical with respect to the ejection port center.--

The paragraph starting at page 38, line 24 and ending at page 39, line 10 has been amended as follows.

--In the present example, since fall speed of the meniscus 102 is faster than shrinkage speed of the bubble 101, as shown in Fig. 12, bubble 101 communicates with the atmosphere in the vicinity of the lower surface of the ejection port 832 about 4 μs after the bubble generation as shown in Fig. 12. In this case, the liquid (ink) in the vicinity of a center axis of the ejection port 832 sinks toward the heater 931. This is because the liquid (ink) Ia [1a] drawn back toward the heater 931 by a negative pressure of the bubble 101 before communicating with the atmosphere holds its speed in a surface direction of heater 931 by inertia even after the communication of the bubble 101 with the atmosphere.--

The paragraph starting at page 39, line 24 and ending at page 40, line 9 has been amended as follows.

--Thereafter, a liquid portion Ib [1b] between the liquid spread on the surface of the heater 931 and the upside liquid (main liquid droplet) gradually becomes thin, the liquid portion Ib [1b] is cut in the middle of the surface of the heater

931 about 7 μs after the generation of the bubble 101 as shown in Fig. 15, and the portion is separated into the main liquid droplet keeping the speed vector in the ejection direction and a liquid Ic [1c] spread on the surface of the heater 931. As described above, a separation position is preferably inside the liquid channel 1338, more preferably on the side of the electrothermal conversion member 931 rather than on the side of the ejection port 832.--

The paragraph starting at page 40, line 19 and ending at line 27 has been amended as follows.

--Since the satellite droplet can be inhibited from being ejected in this manner, a splash due to the ejection of the satellite droplet can be prevented from occuring, and the recording surface of the recoding material can securely be prevented from becoming dirty owing to floating mist. In this regard, in Figs. 12 to 15, Id [1d] denotes an ink (ink in the groove) adhering to the groove portion, and Ie [1e] denotes an ink remaining in the liquid channel.--

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE CLAIMS

1. (Amended) An aqueous ink composition for ink jet comprising:

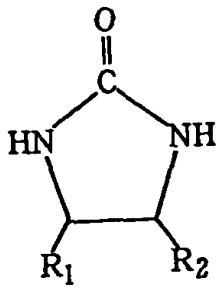
(i) a resin encapsulating a colorant and having a cationic hydrophilic group,

(ii) a self-dispersing pigment having a cationic hydrophilic group bonded to the surface directly or via another atomic group, or [colorant-containing resin fine particle,] a pigment fine particle dispersed with a dispersant having a cationic hydrophilic group; [and]

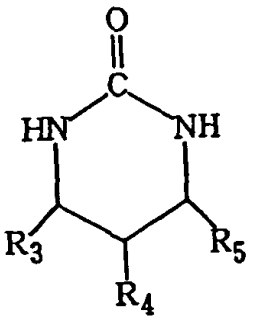
(iii) a polyhydric alcohol; and

(iv) [, said composition further comprising at least one of] a compound selected from the group consisting of a compound represented by the following general formula (I), [and] a compound represented by the following general formula (II), and mixtures thereof:

General formula (I)



General formula (II)



wherein R_1 to R_5 are independently each a hydrogen atom, CH_3 or C_2H_5.

2. (Amended) The aqueous ink composition according to claim 1, wherein the pigment <u>of (ii) is a self-dispersing pigment having a</u> [fine particle has a cationic hydrophilic group or the pigment fine particle is dispersed with a dispersant having a cationic hydrophilic group, and the resin fine particle has the]

cationic hydrophilic group bonded to the surface directly or via another atomic group.

3. (Amended) The aqueous ink composition according to claim 1 [or 2], wherein the colorant of (i) is a pigment [fine particle is self-dispersible carbon black to the surface of which at least one hydrophilic group is bonded directly or via another atomic group].

4. (Amended) The aqueous ink composition according to claim 1, wherein the colorant of (i) and the pigment of (ii) are carbon black [resin fine particle has a cationic hydrophilic group on the surface thereof].

6. (Amended) The aqueous ink composition according to claim 1, wherein said polyhydric alcohol is at least one selected from the [a] group consisting of glycerin, propylene glycol, 1,5-pentanediol, 1,2,6-hexanetriol, and hexylene glycol, and the amount of said polyhydric alcohol is in a range of 0.1 to 10 wt%.

8. (Amended) An ink cartridge comprising an ink container containing an aqueous ink composition for ink jet comprising:

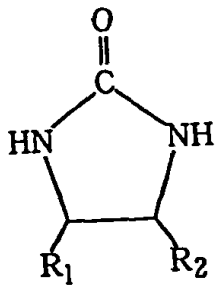
(i) a resin encapsulating a colorant and having a cationic hydrophilic group,

(ii) a self-dispersing pigment having a cationic hydrophilic group bonded to the surface directly or via another atomic group, or [colorant-containing resin fine particles, pigment fine particles,] a pigment fine particle [polyhydric alcohol], dispersed with a dispersant having a cationic hydrophilic group;

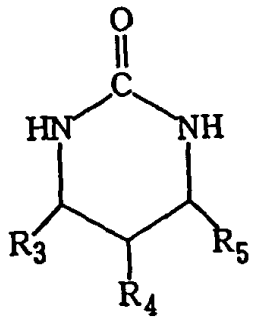
(iii) a polyhydric alcohol; and

(iv) [at least one of] a compound selected from the group consisting of a compound represented by the following general formula (I), [and] a compound represented by the following general formula (II), and mixtures thereof:

General formula (I)



General formula (II)



wherein R_1 to R_5 are independently each a hydrogen atom, CH_3 or C_2H_5.

9. (Amended) A recording unit comprising an ink container containing an aqueous ink composition for ink jet comprising:

(i) a resin encapsulating a colorant and having a cationic hydrophilic group,

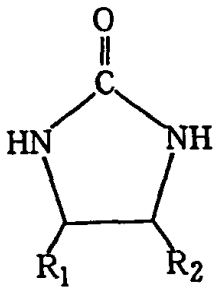
(ii) a self-dispersing pigment having a cationic hydrophilic group bonded to the surface directly or via another atomic group, or a [colorant-containing resin fine particles,] pigment fine particle [particles,] dispersed with a dispersant having a cationic hydrophilic group;

(iii) a polyhydric alcohol;[,] and

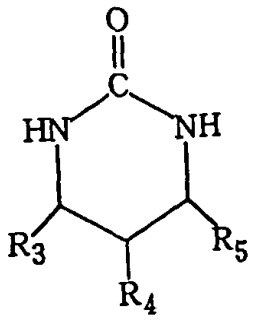
(iv) [at least one of] a compound selected from the group consisting of a compound represented by the following general formula (I), [and] a compound represented by the following general formula (II), and mixtures thereof; and

an ink jet head for ejecting the ink:

General formula (I)



General formula (II)



wherein R_1 to R_5 are independently each a hydrogen atom, CH_3 or C_2H_5.

10. (Amended) An ink jet recording apparatus comprising an ink container containing an aqueous ink composition for ink jet comprising:

(i) a resin encapsulating a colorant and having a cationic hydrophilic group,

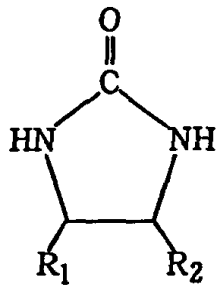
(ii) a self-dispersing pigment having a cationic hydrophilic group bonded to the surface directly or via another atomic group, or a [colorant-containing resin fine particles,] pigment fine particle [particles,] dispersed with a dispersant having a cationic hydrophilic group;

(iii) a polyhydric alcohol;[,] and

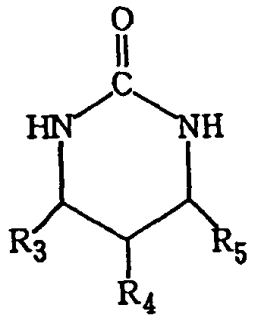
(iv) [at least one of] a compound selected from the group consisting of a compound represented by the following general formula (I),[and] a compound represented by the following general formula (II), and mixtures thereof; and

an ink jet head for ejecting the ink:

General formula (I)



General formula (II)



wherein R_1 to R_5 are independently each a hydrogen atom, CH_3 or C_2H_5.

11. (Amended) An ink jet recording method comprising a step of applying an aqueous ink composition for ink jet to a

recording material by an ink-jet process, said aqueous ink composition comprising:

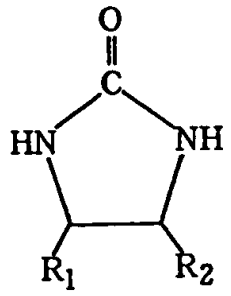
(i) a resin encapsulating a colorant and having a cationic hydrophilic group,

(ii) a self-dispersing pigment having a cationic hydrophilic group bonded to the surface directly or via another atomic group, or [colorant-containing resin fine particles,] pigment fine particle [particles and] dispersed with a dispersant having a cationic hydrophilic group;

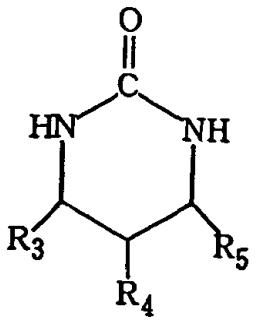
(iii) a polyhydric alcohol;[,] and

(iv) [at least one of] a compound selected from the group consisting of a compound represented by the following general formula (I), [and] a compound represented by the following general formula (II), and mixtures thereof:

General formula (I)



General formula (II)



wherein R_1 to R_5 are independently each a hydrogen atom, CH_3 or C_2H_5.

x